Maddalen

NORTH ATLANTIC TREATY ORGANIZATION
ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD

NATO STANDARDIZATION AGENCY (NSA)
AGENCE OTAN DE NORMALISATION (AON)
1110 BRUSSELS

29 April 2002 NSA/0464-PPS/4224

See CNAD AC/310 STANAG distribution

STANAG 4224 PPS (EDITION 3) – LARGE CALIBRE ARTILLERY AND NAVAL GUN AMMUNITION GREATER THAN 40MM, SAFETY AND SUITABILITY FOR SERVICE EVALUATION

References:
a. AC/310-D/183, dated 12 October 2000 (Edition 3)(Ratification Draft)
b. MAS/312-PCS/4224 dated 4 December 1996 (Edition 2)

1. The enclosed NATO Standardization Agreement which has been ratified by nations as reflected in page (iii) is promulgated herewith.

2. The references listed above are to be destroyed in accordance with local document destruction procedures.

3. AAP-4 should be amended to reflect the latest status of the STANAG.

ACTION BY NATIONAL STAFFS

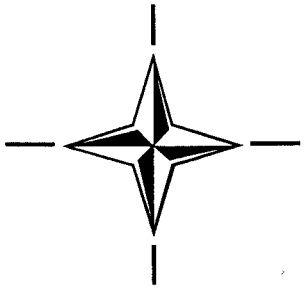
4. National staffs are requested to examine page (iii) of the STANAG and, if they have not already done so, advise the Defence Support Division through their national delegation as appropriate of their intention regarding its ratification and implementation.

Jan H ERIKSEN
Rear Admiral, NONA
Director, NSA

Enclosure:
STANAG 4224 (Edition 3)

STANAG 4224
(Edition 3)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)



NATO STANDARDIZATION AGENCY
(NSA)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: LARGE CALIBRE ARTILLERY AND NAVAL GUN AMMUNITION GREATER THAN 40MM, SAFETY AND SUITABILITY FOR SERVICE EVALUATION

Promulgated on 29 April 2002

Jan H ERIKSEN
Rear Admiral, NONA
Director, NSA

STANAG 4224
(Edition 3)

RECORD OF AMENDMENTS

No.	Reference/date of amendment	Date entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Director, NSA under the authority vested in him by the NATO Military Committee.

2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "In NATO Standardization, the fulfilment by which a member nation formally accepts, with or without reservation, the content of a Standardization Agreement" (AAP-6).

5. Implementation is "In NATO Standardization, the fulfilment by a member nation of its obligations as specified in a Standardization Agreement" (AAP-6).

6. Reservation is "In NATO Standardization, the stated qualification by a member nation that describes the part of a Standardization Agreement that it will not implement or will implement only with limitations" (AAP-6).

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7. Page (iii) gives the details of ratification and implementation of this agreement. If no details are shown it signifies that the nation has not yet notified the tasking authority of its intentions. Page (iv) (and subsequent) gives details of reservations and proprietary rights that have been stated.

FEEDBACK

8. Any comments concerning this publication should be directed to NATO/NSA - Bvd Leopold III, 1110 Brussels - BE.

STANAG 4224
(Edition 3)

NAVY/ARMY

NATO STANDARDIZATION AGREEMENT
(STANAG)

LARGE CALIBRE ARTILLERY AND NAVAL GUN AMMUNITION GREATER THAN 40MM, SAFETY AND SUITABILITY FOR SERVICE EVALUATION

Annexes:

A. Propellant safety test
B. Projectile strength of design test
C. Projectile safety test
D. Worn barrel test
E. Sequential environmental test
F. Underwater shock test
G. Electromagnetic radiation (Naval Environment)

Related Documents:

AECP-1	Mechanical Environmental Conditions to Which Materiel Intended for use by NATO Forces Could be Exposed.
AECTP-300	Climatic Environmental Tests
AECTP-400	Mechanical Environmental Tests
AOP-15	Guidance on the Assessment of the Safety and Suitability for Service of non-nuclear Munitions for NATO Armed Forces
AOP-24	Electrostatic Discharge, Munitions Assessment and Test Procedures
STANAG 1307	Maximum NATO Naval Operational Electromagnetic Environment Produced by Radio and Radar
STANAG 2345	Evaluation and Control of Personnel exposure to Radio Frequency Fields –3KHz to 300 GHz
STANAG 2895	Extreme Climatic Conditions and Derived Conditions for Use in Defining Design/Test Criteria for NATO Forces Materiel
STANAG 4110	Definition of Pressure Terms and Their Interrelationship for Use in the Design and Proof of Cannons and Ammunition
STANAG 4113	Pressure measurement by Crusher Gauge
STANAG 4117	Explosive, Stability Test Procedures and Requirements for Propellants Stabilised with Diphenylamine, Ethyl Centralite or a Mixture of Both
STANAG 4123	Determination of the Classification of Military Ammunition and Explosives – AASTP-3.
STANAG 4147	Chemical Compatibility of Ammunition Components with Explosives and Propellants (Non-Nuclear Applications)
STANAG 4157	Fuzing Systems: Test Requirements for Assessment for Safety and Suitability for Service
STANAG 4170	Principles and Methodology for the Qualification of Explosive Materials for Military Use

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STANAG 4187	Fuzing Systems - Safety Design Requirements
STANAG 4234	Electromagnetic Radiation (Radio Frequency) 200khz to 40 ghz Environment - Affecting the Design of Materiel for Use by NATO Forces
STANAG 4235	Electrostatic Environmental Conditions Affecting the Design of Materiel for Use by NATO Forces
STANAG 4236	Lightning Environmental Conditions Affecting the Design of Materiel for Use by NATO Forces
STANAG 4239	Electrostatic Discharge, Munitions Test Procedures – AOP-24
STANAG 4240	Liquid Fuel Fire Test for Munitions
STANAG 4241	Bullet Attack Test for Munitions
STANAG 4242	Vibration Test Methods and Severities for Munitions Carried in Tracked Vehicles – AOP-34
STANAG 4324	Electromagnetic Radiation (Radio Frequency) Test Information to Determine the Safety and Suitability for Service of EEDs and Associated Electronic Systems in Munitions and Weapon Systems
STANAG 4327	Lightning, Munitions Assessment and Test Procedures – AOP-25
STANAG 4370	Environmental Testing
STANAG 4375	Safety Drop Tests for Munitions
STANAG 4382	Slow Heating Test for Munitions
STANAG 4396	Sympathetic Reaction, Munition Test Procedures

AIM

1. The aim of this agreement is to establish within NATO a uniform method for the assessment and testing of the safety and suitability for service of large calibre artillery and naval gun ammunition of greater than 40mm. Tank and mortar ammunition are excluded.

AGREEMENT

2. Participation nations agree that:

a. Analysis, as described in AOP-15, will be conducted for the assessment and testing of the safety and suitability for service of large calibre artillery and naval gun ammunition of greater than 40mm.

b. Data developed in accordance with this STANAG shall be made available to other NATO nations participating in a collaborative weapon development or procurement programme upon receipt of a request submitted through appropriate national channels.

c. Any significant proposed changes to the agreed procedures for the safety and suitability for service evaluation will be provided to the participating nations for comment and concurrence; any changes made without the mutual acceptance of the ratifying nations may negate the acceptability of the test results.

DEFINITIONS

3. The following terms and definitions are used for the purpose of this agreement:

a. Pressure terms. The pressure related terms and definitions used in the document conform to STANAG 4110 with the following additions:

(1) System Design Pressure (System DP). The value of Cannon DP or Projectile DP (whichever is the lower) for a specified system.

(2) Chamber Pressure. The peak pressure measured by pressure transducers or crusher gauges, in one or more points in the weapon chamber/tube. The actual types and positioning of the pressure transducers and pressure gauges shall be defined and should be consistent for a particular cannon system.

b. Lower Conditioning Temperature (LCT). The temperature to which test items are stabilized for cold tests. This temperature is based on the climatic region that the testing nation and the using nation predict to be the worst case cold environment that the test item will encounter during storage and transportation (See Table 1).

c. Lower Firing Temperature (LFT). The temperature to which test items are stabilized for cold test firing. This temperature is based on the climatic region that the testing nation and the using nations predict to be the worst case cold firing environment that the test item will encounter during operations (See Table 1).

d. Upper Conditioning Temperature (UCT). The temperature to which test items are stabilized for hot tests. This temperature is based on the climatic region that the testing nation and the using nations predict to be the worst case hot environment that the test item will encounter during storage and transportation. (See Table 1).

e. Upper Firing Temperature (UFT). The temperature to which the test items are stabilized for hot test firing. This temperature is based on the climatic region that the testing nation and the using nations predict to be the worst case hot firing environment that the test item will encounter during operations. (See Table 1).

f. Safety. Freedom from hazards to personnel and material at all times recognizing the considerations of operational necessity as a limiting factor.

g. Suitability for Service. The property by which a munition is capable of functioning as designed, without unacceptable degradation of this functioning or of safety by the service environment throughout the agreed service life. It does not include effectiveness on target.

h. Muzzle Velocity (MV). The velocity of the projectile at exit of the projectile base from the muzzle of the barrel (including any muzzle brake or similar devices if fitted).

i. Firing Interval. The elapsed time from application of primer initiation energy to the moment of projectile base exit from the muzzle of the barrel.

j. Temperature Coefficients. The variations per ^{O}C with respect to chamber pressure or MV, as specified. Temperature coefficients should be specified in terms of temperature ranges between LFT and UFT.

k. Packaged Ammunition. The ammunition in its full-service logistic packaging.

l. Intermediate Packaging. Inner packing for tactical transportation, if applicable.

m. Ignition Delay. Time lapse between the moment of administration of the firing signal, or firing stimulus to the primer and the moment of irreversible function of the explosive train, or the moment a specified condition is reached, such as a gas pressure in a combustion chamber.

GENERAL

4. Procedures

a. Each nation will be responsible for the safety and suitability for service assessments of ammunition to be used by its own services and, for this purpose, will require copies of relevant design parameters, assessments, and test reports of the nation developing the ammunition. Nations which have developed the ammunition and/or conducted assessments and tests, agree to make the reports available to the other nations on receipt of a valid request.

b. Notwithstanding the intention to avoid duplication of testing, each nation reserves the right to carry out additional testing if considered necessary and, when necessary, to bear the financial, technical and safety consequences of conducting the tests. Nations requiring the additional test may obtain assistance, under conditions to be negotiated, from the developing nation.

c. There may be inherently different environmental hazards and operational philosophies which affect safety and suitability for service assessments by particular nations. A specific test programme need not be limited to or include all tests described in this document except in the case of standard (mandatory) tests (para. 13a). The selection of tests and test parameters shall be based on the measured or analytically forecasted life cycle environmental profile, using guideline documents such as STANAGs 2895, AECP-1 and AOP-15.

d. No individual test or group of tests can be assessed in isolation; therefore, to make a valid assessment of the ammunition in its expected service life environment, the final safety and suitability for service assessment recommendation needs to consider both development tests as well as the individual national evaluation procedures.

e. Test Items. Tests should be conducted on the final design of the ammunition which has been manufactured to production standards and is ready to be fielded. Deviations and waivers from this design shall be identified. Design or production changes after fielding shall be identified and supporting information to confirm the validity of original tests as affected by these changes shall be provided. Items within the ammunition may be substituted by non-functional items provided this does not detract from the purpose of the test or test sequence. The configuration shall be specified in detail in the test plan and reported in the test report.

f. Explosive Qualification and Final (Type) Qualification. Evidence shall be provided by the developing nation that the explosive and propelling charge compositions to be used in the ammunition have been assessed and qualified to the requirements of STANAG 4170. These include propellant stability tests in accordance with STANAG 4117, and chemical/physical compatibility in accordance with STANAG 4147, where appropriate.

g. UN Classification. Evidence shall be provided by the developing nation that the ammunition has been given a UN classification valid to its design and packaging in accordance with UN recommendations on the Transport of Dangerous Goods and STANAG 4123(Edition 2).

h. Fuzes and Safety and Arming Devices. Evidence shall be provided by the developing nation to the requesting nation that the fuzes and safety and arming devices used have been designed and assessed in accordance with STANAG 4187 and STANAG 4157 respectively.

5. Prerequisites. For all firing tests where peak chamber pressure and/or muzzle velocity measurements are required, the following prerequisite information shall be provided by the developing nation upon request.

a. The actual type and positioning of pressure transducers or pressure gauges which should be consistent for a particular cannon/gun system.

b. Adjustment criteria among pressure transducers, pressure gauges and absolute or true pressure, if any.

c. Adjustment criteria for different number of pressure gauges.

d. Propellant-proof specification. Propellant-proof results and adjusted charge weight (ACW) for the lot(s) under test. Incremental values (ACW/MV/pressure/temperature).

e. Temperature coefficients.

f. Adjustment criteria for different projectile weight.

g. Adjustment criteria for barrel wear.

h. The method of determining muzzle velocity (MV).

i. The method of determining projectile base exit.

6. Temperatures. Conditioning and firing temperatures are given in Table 1 (See page 9) Temperature conditioning durations are given in Table 2 (See page 9).

7. Projectile Related Tests. Projectile safety test firings shall be carried out with propelling charges which produce the extreme interior ballistic conditions which the projectile may experience in service. Any one or more of the different parameters given below may have to be selected for a particular type of projectile. The parameter chosen shall be defined in the test report.

a. Maximum projectile base pressure. This is usually at, or as close as possible to, Projectile DP (or System DP).

b. Maximum acceleration, rate of change of acceleration or pressure gradient likely to cause greatest stress.

c. The maximum expected velocity/spin levels.

If these conditions cannot be produced with a service charge, then one or more special charges shall be used.

8. Propellant Related Tests. In the safety evaluation of propellant, the specified test procedures shall be used to confirm that muzzle velocity, pressure levels, and performance characteristics are safe and meet the operational requirement.

9. Extreme Service Conditions. Nations reserve the right to conduct testing to standards more severe than specified in this STANAG, providing the developing nation is consulted to ensure that such testing would not be detrimental to the safety of the ammunition based on previous test results, design parameters, or safety assessments. The results are to be made available to other nations upon receipt of a valid request.

10. Safety and Suitability for Service Tests. An assessment which includes any or all of the tests included in this document must utilize the test procedures specified. Any tests not included in this document which are considered necessary by the testing nation will be carried out in accordance with national procedures detailing the required severity and methods of the test.

11. Combining of Tests. The tests given in this document are described as individual and separate tests apart from the Sequential Environmental Test. In order to save time and cost, tests may be combined with other tests, for example fuze evaluation, accuracy, lethality, and terminal performance when test facilities permit and the developer has high confidence in the survivability of the ammunition. However, the requirements specified in this document for individual tests shall be achieved.

12. Assessment Criteria. These tests are conducted to ensure that test items are safe and suitable for service during storage, transportation, handling, firing, flight and disposal. Assessment criteria for tests discussed in this STANAG are specified in the respective Annexes. For other applicable tests identified by this STANAG, the assessment criteria are given in the STANAG for that particular test when available or identified in national procedures.

13. Test Index - Artillery and Naval Gun Ammunition. Prior to commencement of any of these tests, the assessment required at para 4(f), (g) and (h) above, shall be completed with satisfactory results as applicable to the ammunition under test. National procedures should be used for those tests not included as an Annex to this document or covered by a relevant STANAG. The tests required will be based on an environmental and hazard analysis in accordance with AOP-15 and the design of the ammunition.

a. Standard (Mandatory) Tests. The following tests which simulate extreme environmental conditions shall be performed as part of the safety and suitability for service test programme: Tests (1) through (6) are mandatory for all ammunition; the additional tests (7) through (12) are mandatory for any ammunition to be embarked on naval vessels.

(1) Safety Drop (STANAG 4375)

(2) Propellant Safety (Annex A)

(3) Projectile Strength of Design (Annex B)

(4) Projectile Safety (Annex C)

(5) Worn Barrel (Annex D)

(6) Sequential Environmental (Annex E)

(7) Liquid Fuel Fire (STANAG 4240)

(8) Sympathetic Reaction (STANAG 4396)

(9) Slow Heating (Slow Cook-off) (STANAG 4382)

(10) Bullet Attack (STANAG 4241)

(11) Underwater Shock (Annex F)

(12) Electromagnetic Radiation (Naval Environment) (Annex G)

b. Supplementary tests. The tests below may be required in addition to the Standard tests above, as dictated by the results of the logistics and hazards analyses per AOP-15 and the item design. As an interim measure, national procedures should be used for the conduct of these tests until NATO procedures are agreed and published.

General

(1) Projectile Fallback

(2) Low Charge Firings

(3) Flick Ramming

(4) Safe Functioning - (High rate firing gun systems)

(5) Muzzle Blast Overpressures

(6) Environmental Electrostatic Discharge and Lightning (STANAG 4235, 4236, 4239, 4324 and 4327)

(7) Cook-off in Hot Gun

Mechanical

(8) Air Delivery/Parachute Drop

(9) 3 Meter Safety Drop (STANAG 4375)

(10) Transportation-Vibration (STANAG 4370, AECTP-400, Method 401)

(11) Mechanical Shock (STANAG 4370, AECTP-400, Method 403)

Climatic

(12) Constant High Temperature (STANAG 4370, AECTP-300, Method 302)

(13) Constant Low Temperature (STANAG 4370, AECTP-300, Method 303)

(14) Low temperature/low pressure (Rapid Decompression) (STANAG 4370, AECTP-300, Method 312)

(15) Solar Radiation (STANAG 4370, AECTP-300, Method 305)

(16) Dust/Sand (STANAG 4370, AECTP-300, Method 313)

(17) Mud

(18) Driving Rain (STANAG 4370, AECTP-300, Method 310)

(19) Immersion (leakage) (STANAG 4370, AECTP-300, Method 307)

(20) Pressure differential (sealing)

Chemical/Biological

(21) Mould/Fungus growth (STANAG 4370, AECTP-300, Method 308)

(22) Salt Fog (corrosion) (STANAG 4370, AECTP-300, Method 309)

(23) Material Compatibility with Energetic Components

(24) Contamination by Fluids (STANAG 4370, AECTP-300, Method 314)

(25) Toxicity

Radiation

(26) Radiation from Nuclear Explosion

(27) Radio Frequency Hazards (STANAG 2345)

(28) Radiation emission - Hazards to Personnel

Fire and Explosion

(29) Hostile action - Vulnerability

(30) Spall Impact

(31) Shape Charge Jet Impact

(32) Fragment attack

The above list is not comprehensive. Other tests may be necessary and may be conducted in accordance with national documents, or STANAG's if available.

c. Packaging tests. Most of the above tests are designed to assess ammunition, where ammunition is tested in packaging which has been separately tested and approved. If this is not the case, additional tests of the packaging should be carried out under national test procedures.

IMPLEMENTATION OF THE AGREEMENT

14. This STANAG is considered implemented by a nation when that nation:

a. has revised or issued applicable national documents to agree with the provisions of the STANAG;

b. has issued the necessary order/instructions to its forces putting the procedures detailed in this agreement into effect.

TABLE 1 - CLIMATIC CATEGORY TEMPERATURES

Testing shall be carried out at temperatures representative of the extreme conditions likely to be encountered in service. The Climatic Categories in which the ammunition shall be used, and has been designed and tested for, shall be specified by the nation developing the ammunition. The temperature ranges and diurnal cycles for the various Climatic Categories are given in STANAG 2895. The extreme conditioning and firing temperatures to be used during safety testing of ammunition are derived from these and are given below:

Climatic	Conditioning (LCT,UCT)	Firing (LFT, UFT)
Category	Temp ^{o}C	Temp ^{o}C
A1/B3/M1	63	63
A2/B2/M2	63	56
A3	58	52
C1/M3	-33	-33
C2	-46	-46
C3	-51	-51

TABLE 2 - CONDITIONING DURATIONS

When conditioning ammunition, the durations given below shall be used as a minimum:

Calibre (mm)	40	57	76	90	100	105	120	155	165	203
Duration (h)	4	7	8	13	15	18	20	22	23	26

The above durations are the minimum to achieve the required effect for ammunition either unpackaged or in intermediate packaging and racked separately in a conditioning chamber with good air circulation. Where ammunition shall be conditioned in logistic packaging (such as a Unit Load Container (ULC) or pallet) then conditioning durations should be increased until the temperature of test item has stabilized to within ± 2°C of desired test temperature. The recommended conditioning durations are not to be extended beyond a total of 36 hrs for temperatures above 50°C without the advice of the developer.

Note. To derive minimum conditioning duration for ammunition of calibre not specified in the table above, the following equation may be used:

a. **For calibre** ≤ 105mm.

$D = 0.1016 + 0.0516 \times S + 0.0009946 \times S^2$

b. **For calibre** > 105mm.

$D = 16.8414 - 0.0013 \times S + 0.0002292 \times S^2$

D = Duration of Conditioning (hr)

S = Ammunition Calibre (mm)

ANNEX A to
STANAG 4224
(Edition 3)

PROPELLANT SAFETY TEST

AIM

1. To determine if a propelling charge is safe and suitable for service use with a specified projectile and cannon.

GENERAL

2. This test is conducted in two parts with two separate lots of propelling charges and provides the primary evidence to assess whether a propelling charge is safe and suitable for service use.

3. The data from the test will be examined for the following:
   a. Satisfactory charge ignition (ignition delay)
   b. Evidence of pressure/time curve irregularities
   c. Evidence of unacceptable differential pressures

4. Data obtained during the test will be used to establish the following:
   a. Pressure and muzzle velocity levels and standard deviations at the LFT, 21°C and the UFT.
   b. Pressure and muzzle velocity temperature coefficients

5. Propelling charges used for this test may be either unconditioned or those that have undergone the environmental portion of the sequential environmental tests, provided the charge produces the highest peak chamber pressure. Either service or proof projectiles may be used.

TEST EQUIPMENT

6. The barrels used in this test shall have only been fired for barrel proof (new barrel). The purpose of this test is to examine worst case internal ballistics which usually occur under new barrel or top of ballistic hump conditions. Development tests should provide evidence of which of these is to be used to select suitable barrels. A different barrel may be required for the Part 1 test than those used in Part 2. The barrels are to be complete with fume extractors and muzzle brakes, if applicable.

7. The propelling charges selected for this test should be from two full size lots of mass production. Alternatively, pre-production samples may be used provided they conform to the final in-service design and production method. One of the lots selected for the test shall be from as near to the top end of the propellant proof/pressure specification as possible.

8. Service or inert filled projectiles (with inert fuzes or plug representing fuze (PRF)) may be used. Alternatively, proof projectiles may be used provided their internal ballistic characteristics are the same as those of service projectiles. If not, where the differences are small and the effects are known from development tests, necessary adjustments to the results can be made. Ideally, projectile weight should be within the top 25% of the production specification tolerance in order to reduce the amount of pressure adjustment required. The use of projectile with maximum driving/obturator band strength and diameter to produce maximum projectile start pressures is to be considered.

ANNEX A to
STANAG 4224
(Edition 3)

INSTRUMENTATION

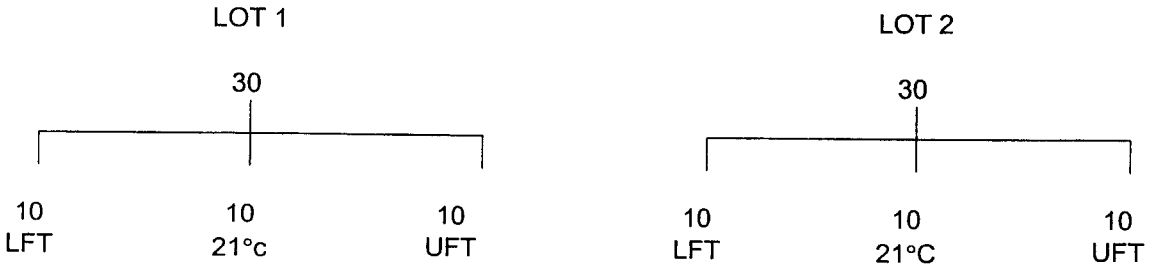
9. Chamber pressure is to be measured by pressure transducer (STANAG not yet available) and crusher gauges (STANAG 4113). For pressure differential recording during Part 1 of the test, the forward pressure transducer should be as far forward in the chamber as possible and ideally just behind the projectile base. The types and positions of forward and rear transducers are to be included in the test report. Crusher gauges alone may be used for Part 2 of the test.

PART 1

10. Aim The aim of Part 1 is to assure that the propelling charge meets the specification values and is satisfactory for use in further tests.

11. General Ten round groups shall be fired at the LFT, 21° C, and at the UFT in one barrel using 2 lots of propellant. Muzzle velocity, chamber pressure, firing interval, ignition delay, pressure/time curves and differential pressures shall be recorded for all rounds. Additional firings at intermediate firing temperatures may be carried out to examine linearity of temperature coefficients.

12. Test Outline



a. Both the projectile and the propelling charge, including any separate charge-initiating explosive device, shall be at the required temperature.

b. Firing should be in accordance with the following sequence. Alternate sequences may be used as long as they do not allow other biases. Two warmer rounds shall be fired at the beginning of each firing day. One anti-interference and/or warmer round shall be fired between temperature groups.

Lot 1			Lot 2		
LFT	21° C	UFT	LFT	21° C	UFT
1	21	41	2	22	42
3	23	43	4	24	44
5	25	45	6	26	46
7	27	47	8	28	48
9	29	49	10	30	50
11	31	51	12	32	52
13	33	53	14	34	54
15	35	55	16	36	56
17	37	57	18	38	58
19	39	59	20	40	60

c. A consistent rate of fire is required during each temperature series. Usually this will be 6-8 minutes per round.

d. Breech opening should be automatic if applicable. (See the requirements of paras. 13 m, n and o).

13. Data. The following data shall be recorded and are to be included in the test report:

a. Configuration and identification of projectile, charge, cannon, instrumentation, and firing site.

b. Barrel wear and ammunition history before the start and at end of test.

c. Ammunition stabilization temperature.

d. Date of firing and time.

e. Weight of projectile, charge and, where applicable, combustible cartridge components.

f. Firing interval.

g. Ignition delay.

h. Copies of pressure/time curves.

i. Copies of differential pressure/time curves

j. Muzzle velocity (MV).

k. Peak chamber pressures by pressure transducer (front and rear) and each individual crusher gauge.

l. Maximum peak to peak pressure differentials.

m. Residue in the chamber or bore.

n. Any evidence of flash-back or after burn.

o. Any evidence of muzzle or breech smoke or flash.

p. Prior tests to which charges have been subjected.

q. Any evidence of excessive coppering, if applicable.

r. Breech configuration.

s. Fall of shot (impact location).

14. Data Reduction. The method of data reduction shall be reported.

a. The following data reduction processes shall be completed and results recorded in the test report:

(1) Calculations of MV.

(2) Adjustments for the volumetric effect of inclusion of crusher gauges, if applicable.

(3) Calculations of mean peak chamber pressure for each round when more than one crusher gauge is used. The rejection criteria for unacceptable crusher gauge readings and the treatment of split results shall be reported.

b. The following data reduction processes, as applicable, shall also be carried out but may be separately reported.

(1) Adjustments to new barrel or top of ballistic hump conditions.

(2) Adjustments to top weight or weight zone projectile.

(3) Adjustments to upper pressure limit of propellant proof (UPLPP).

(4) Adjustments between pressure transducers and crusher gauge results, if applicable.

(5) Mean and sd values for each lot and temperature of firing of the following:

- Firing interval
- Ignition delay
- MV
- Peak chamber pressure
- Maximum peak to peak pressure differential

Data should be examined for any effects due to barrel wear, barrel warming or barrel memory. Corrections or rejections due to these effects shall be reported.

(6) Temperature co-efficients.

15. Assessment Criteria. The propelling charge shall be assessed using the following criteria:

a. The ignition delay is to be within the specification. There shall be no misfires or hangfires attributable to the charge.

b. The pressures and MV measured at the 3 temperatures shall be consistent with the propellant specification for these temperatures. The pressure records at the LFT are to be examined for any evidence of propellant break-up or shatter as may be indicated by such as abnormally high pressure at the LFT or a high sd in pressure.

c. The Pressure transducer readings and the pressure/time curves are to be examined for differential pressure, transient pressure peaks, or other irregularities which may indicate an unsafe condition within the chamber.

d. The temperature/pressure coefficients between 21 C and the LFT and 21 C and the UFT shall be acceptable in relation to performance requirements which may be specified in the Technical Characteristics.

e. There is to be no residue in the chamber or in the bore which may cause a hazard or affect performance to an unacceptable degree.

f. There is to be no unacceptable flash back or after burn.

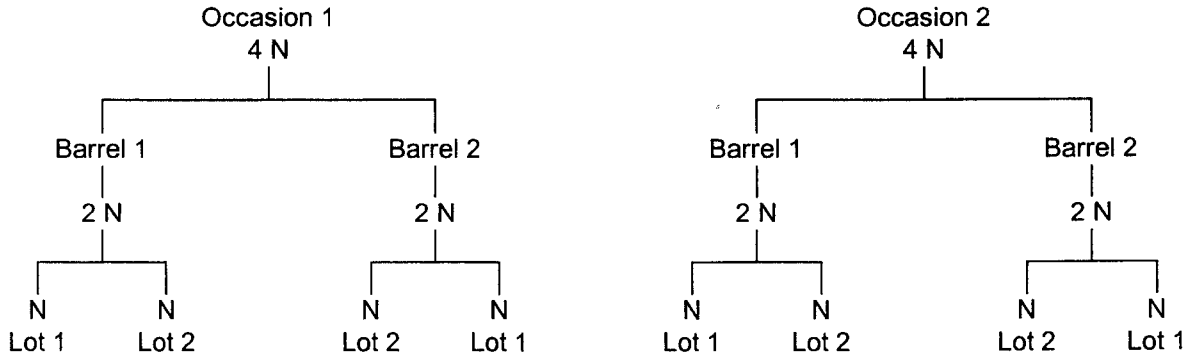
g. The significance of any residue, flash back or after burn shall be explained by the developing nation.

PART 2

16. Aim. The aim of Part 2 is to determine the maximum pressure likely to be obtained in service. This is compared with System DP or System PMP to ensure that the charge is not likely to generate dangerously high pressures.

17. General. The firing shall be carried out in groups of N rounds (N ≥ 7) on two occasions in two new barrels and from two propellant lots at the UFT. For the purpose of statistical analysis, the number of rounds fired per group, from which data can be derived for analysis, is to be not less than seven. Additional number of rounds in each group, number of occasions, number of barrels or number of lots may be used as appropriate, when either chamber pressure variability is unknown or known to be wide. The test requires that the barrels be fired concurrently in sequence and hence the guns are required at the same firing point at the same time.

18. Test Outline



(N ≥ 7)

a. The sequence of firing, for each occasion, shall be:

Barrel 1 Lot 1	Barrel 1 Lot 2	Barrel 2 Lot 2	Barrel 2 Lot 1
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28

b. All firing shall be carried out with the charge (and, if appropriate, the charge initiating explosive device) at the UFT.

c. An occasion is defined as a continuous period of firing during which there are no significant changes in conditions. A new occasion is defined as when the cannon has been taken out of action for a sufficient period for the cannon to return to ambient temperature combined with at least one of the following circumstances:

(1) Another day

(2) A new location

(3) A change in ambient conditions

To allow a clear break between occasions a period of not less than 12 hours between occasions is required.

d. A consistent rate of fire is required throughout each occasion as specified by the developer. Too high a rate of fire may introduce barrel heating effects and too low a rate of fire may introduce occasion-to-occasion effects. Ideally the rate of fire should be 6-8 minutes between rounds, fired from the same barrel.

e. Two or more warmers shall be fired before the first series of each occasion and before recommencement of firing if there is a pause of more than 1 hour in the programme.

f. Barrels shall be sufficiently new to allow examination for ballistic hump, if any. In the case of barrels with chromium plated bores or barrels with very low wear rates, ballistic hump due to coppering, deposits from charge additives, or other aspects may occur much later in barrel life. The appropriate barrels to examine maximum chamber pressure should be chosen accordingly.

19. Data. The following data shall be recorded and are to be included in the test report:

a. Configuration of projectile, charge, cannon and instrumentation, and firing site.

b. Barrel wear and ammunition history of cannon before start of the test. Barrel wear between each occasion and at end of test. Additional barrel wear measurements should be taken during the test, as specified by the developer, on barrels subject to high wear rates.

c. Ammunition temperature (Temperature at which the ammunition has been conditioned).

d. Date of firing, time, and prevailing meteorological conditions.

e. Weight of projectile, charge and, where appropriate, combustible cartridge components.

f. Firing interval.

g. Muzzle velocity (MV).

h. Chamber pressure and method of measurement, to include the number and type of gauges.

i. Any evidence of debris or deposits in the chamber or bore, flash-back or after burn or evidence of muzzle or breech smoke or flash.

j. Prior tests to which charges have been subjected.

k. Fall of shot (Impact location).

20. Data Reduction. The methodology of data reduction shall be reported.

a. The following data reduction processes shall be completed and results recorded in the tests report:

(1) Calculation of MV.

(2) Adjustments for the volumetric effect of inclusion of crusher gauges, if applicable.

(3) Calculations of mean peak chamber pressure for each round when more than one crusher gauge is used. The rejection criteria for unacceptable crusher gauge readings and the treatment of split results shall be reported.

b. The following data reduction processes shall also be carried out but may be separately reported:

(1) Adjustments to new barrel or top of ballistic hump conditions.

(2) Adjustments to top weight or weight zone of projectile.

(3) Adjustments to UPLPP.

(4) Adjustments for difference between pressure transducer and crusher gauge results, if applicable.

(5) The number of missing, and adjustments made for, values of chamber pressure(for example due to instrumentation failures).

(6) Overall mean and sd values of the following, having completed necessary adjustments:

- Firing interval.
- MV.
- Chamber pressure - (The mean of the adjusted chamber pressure is the ESCP).

c. After completion of all the adjustments above, the results shall then be analyzed statistically as per STANAG 4110.

21. Assessment Criteria. Utilizing the definitions and statistical analysis described in STANAG 4110, the following criteria shall be used to address the safety and suitability for service use of the propelling charge:

a. ESCP plus 3 sd's is MOP. MOP shall be equal to or less than System PMP.

b. When System PMP has had to be reduced in order to accommodate a Proof Pressure (PP) wider than 1.75 sd or when it is not possible to accurately define System PMP the results shall be compared with System DP. In this case, ESCP plus 4.75sd shall be equal to or less than system DP to ensure that system DP will not be exceeded by more than 1 in 10^6 rounds.

ANNEX B to
STANAG 4224
(Edition 3)

PROJECTILE STRENGTH OF DESIGN TEST

AIM

1. To determine if the non-explosive parts of the projectile can successfully withstand the maximum firing stresses.

GENERAL

2. Inert-loaded projectiles with inert fuzes are inspected, fired at higher than normal pressures, recovered and reinspected to determine whether any metallurgical failures or dimensional changes have occurred. This test should take place before firing tests are carried out with live projectiles.

TEST PLAN

3. Projectiles. Projectiles used for this test should be representative of full-scale production. If possible special measures should be taken to manufacture or select projectiles at the lower end of the specification for material properties and dimensions within the production specifications. When the development background indicates particular failure modes that may arise from the strength of material or tolerancing, special projectiles should be manufactured to the minimum metal condition and strength permitted within the production specification to test these likely failure modes.

4. Charges

a. Hot conditioned projectiles shall be fired at or above 105% System PMP but not to exceed System DP. This is to be achieved either by heating a suitable charge or by providing a special charge to develop the required chamber pressure or projectile acceleration.

b. Cold conditioned projectiles shall be fired between 3 sd and 4.75 sd above the adjusted mean pressure at the LFT. This is to be achieved either by temperature conditioning a suitable charge or by providing a special charge to develop the required chamber pressure or projectile acceleration.

c. The charge shall be selected to produce either the highest chamber pressure or projectile acceleration depending on expected failure modes. The test may need to be repeated under both conditions.

5. Outline. An outline of the test is given below: Firing shall be conducted in a barrel in its first quarter of life.

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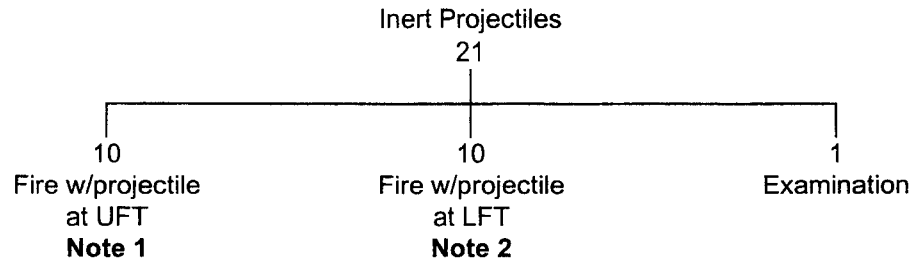

Note 1. Hot conditioned projectiles shall be fired at or above 105% System PMP but not to exceed System DP.

Note 2. Cold conditioned projectiles shall be fired at a pressure between 3 sd and 4.75 sd above the adjusted mean pressure at the LFT.

At least 70% of the projectiles shall be recovered for examination.

DATA

6. The following data shall be recorded and included in the test report:

a. Hardness profile on all projectiles (before firing).

b. On the Examination projectile 0.2% yield strength of material at critical locations.

c. Pre and post firing measurements of front and rear bourrelet diameters and projectile dimensions at appropriate points. Record any deformation.

d. Condition of driving band, band slippage, and band security and quality of engraving, etc. Include photographs, as necessary.

e. Visual and/or metallurgical examination for any break-up, cracks, body engraving, unscrewing of fuze or body sections, base integrity, etc.

f. Behaviour of the projectile at muzzle exit and in its trajectory.

g. Spin rate, as applicable.

h. Photographic evidence of satisfactory projectile launch.

i. Measurement of yaw at launch. For fin stabilized projectile, document any evidence of fin damage.

j. Reference to Technical Data Package (TDP).

k. Chamber pressure and MV.

l. Barrel wear and condition of bore before and after firing test.

m. Firing date and meteorological conditions.

n. Fall of shot (Impact location).

ASSESSMENT CRITERIA

7. Projectiles shall be assessed using the following criteria:

a. The maximum amount of set-up(expansion of the projectile diameter) at any measurement position shall not exceed the difference between the design minimum bore diameter of the barrel and the design maximum projectile body diameter, excluding paint.

b. For HE projectiles, the maximum amount of set-down(contraction of the projectile diameter) at any measurement position shall not exceed 0.5% of the calibre. For cargo projectiles, the set-down shall not be such as to impede the ejection of the payload, nor shall it damage the payload thereby causing a hazard or incorrect functioning of the payload.

c. There shall be no break-up of the projectile, sub-munitions or other payload, or any unacceptable deformation, cracks, body engraving, dimensional changes or other evidence of failure. Where any feature is judged to be unacceptable, its significance is to be assessed by the developing nation.

d. The driving band shall be correctly engraved and show no signs of slippage. The projectile shall achieve the correct spin rate appropriate to the MV recorded. There shall be no permanent deformation of the barrel resulting from the driving band pressure.

e. Fuze, body and base sections shall remain firmly in place.

ANNEX C to
STANAG 4224
(Edition 3)

PROJECTILE SAFETY TEST

AIM

1. To determine if projectiles with HE, other hazardous fillings, submunitions with HE or other hazardous fillings, and non-hazardous projectiles containing explosive or pyrotechnic components are bore and flight safe.

GENERAL

2. This test provides the preliminary evidence to assess whether a projectile is prone to premature detonation or other reactive material function in the bore or during flight. The test should be carried out after completion of the Strength of Design test which assesses the strength of the non-explosive parts of the projectile. The test gives an initial assurance that the projectile is safe before carrying out the Sequential Environmental test.

3. This test subjects projectiles to pre-stressing by means of drop and bounce tests conducted at the temperature extremes, followed by hot diurnal cycling. Projectiles are then fired at an elevated chamber pressure, acceleration or rate of change of acceleration that the projectile might encounter in service.

4. This full test is mandatory for HE-filled projectiles and other projectiles with hazardous fillings, including submunitions with HE or other hazardous fillings. For non hazardous projectiles containing explosive or pyrotechnic components and which will not produce a catastrophic barrel failure or other personnel hazard in the event of a malfunction, the test sample quantities may be reduced by 50%.

5. A minimum of 60 projectiles selected from main production are subjected to this test. . For non hazardous projectiles defined in paragraph 4 above, a minimum of 30 projectiles is required. If the projectile incorporates features not previously proven in service or utilizes new explosive materials or is subjected to dynamic conditions more severe than previously tested, the number of projectiles to undergo this test may need to be increased to 120. For cargo rounds which dispense submunitions with HE or other hazardous fillings, 20 of these rounds with either a combination of live fuze/inert charge and inert fuze/live charge submunitions, or live fuze/live charge submunitions shall be fired and functioned in flight.

6. These tests shall be conducted with inert or dummy main projectile fuzes except for the cargo rounds which are fired and functioned in flight. The 40 cargo rounds which are not functioned in flight shall also contain live submunition fuzes.

7. The pre-stressing requirements apply only to the projectile. Cartridge cases (including fixed ammunition) and propelling charges need not be pre-stressed. Test items shall undergo visual and radiographic inspection between subtests.

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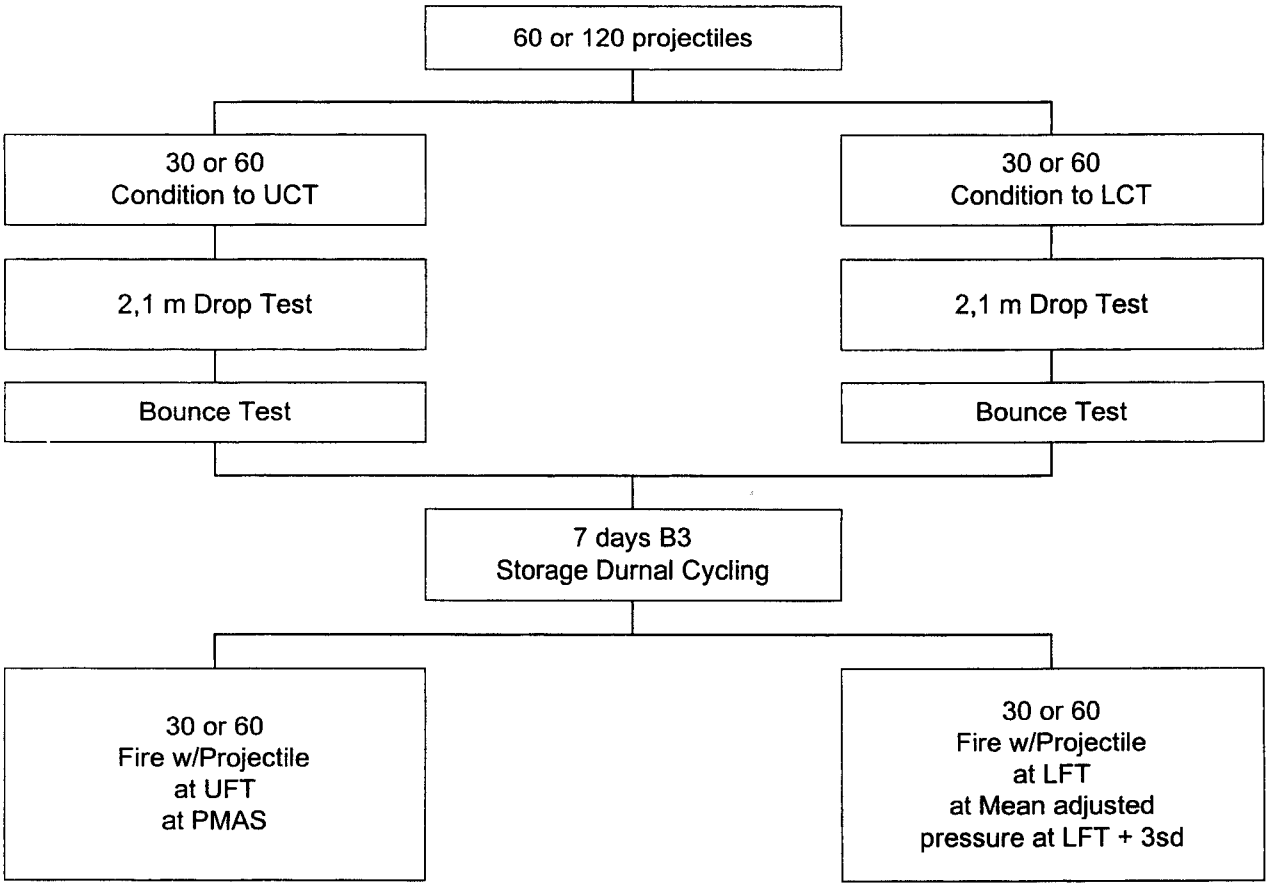
TEST PLAN

8. Outline. An outline of the test is given below:



9. 2.1 Metre Drop Test. Projectiles shall be subjected to a 2.1 m Drop Test in accordance with the procedures defined in STANAG 4375. Each projectile is to be dropped twice as follows:

Conditioned UCT	Drop	Conditioned LCT
AAAAABBBBCCCDDE	N° 1	ABCDEBCDECDEDEE
ABCDEBCDECDEDEE	N° 2	AAAAABBBBCCCDDE

Where:

A = Major axis horizontal
B = Base down
C = Nose down
D = Major axis 800 mils(45°) from vertical, base down
E = Major axis 800 mils(45°) from vertical, nose down.

Note 1. The above drop sequence is for 30 projectiles. The drop sequence shall be repeated for each series of 30 projectiles.

Note 2. Projectiles should be unpackaged. If unacceptable damage for firing occurs in any one drop orientation, then for that orientation either the drop height should be reduced or primary containers used, or some other protection provided.

Note 3. All drop impact orientation tolerances shall be $\pm 5^{\circ}$. If not, the drops shall be repeated with another test item.

10. Bounce/Loose Cargo Test. Projectiles shall be subjected to a Bounce/Loose Cargo Test as follows:

a. Projectiles should be unpackaged. If unacceptable damage for firing occurs, then intermediate packaging should be used.

b. Samples shall be bounced in accordance with STANAG 4370, AECTP-400, Method 406.

11. Diurnal Cycling. All projectiles shall undergo 7 days of (unpackaged) B3 storage diurnal cycling as specified in STANAG 2895. This temperature cycling is intended to stress HE fillings or rocket motors (such as base bleed or rocket assist) after the rough handling tests.

12. Firing. Projectiles shall be fired (if not obviously damaged to the extent the projectile could not be fired or would not be fired in service) from a barrel in its first quarter of life at the UFT and LFT appropriate for the Climatic Category for service (Table 1).

a. Hot conditioned projectiles shall be fired by heating a suitable charge or by using a special charge designed to produce PMP or the equivalent maximum acceleration or maximum rate of change of acceleration likely to be experienced in service at the UFT.

b. Cold conditioned projectiles shall be fired by temperature conditioning a suitable charge or by using a special charge designed to produce a pressure level that equates to the mean adjusted pressure at LFT + 3 sd or the equivalent maximum acceleration or maximum rate of change of acceleration likely to be experienced in service at the LFT.

13. Recovery

a. Ten hot and ten cold-conditioned projectiles should, if possible, be recovered after firing for radiographic examination and, if necessary, sectioning.

b. A portion of the ejected submunitions should, if possible, be recovered after firing for radiographic examination and, if necessary, sectioning.

DATA

14. The following data shall be recorded and included in the test report:

a. Prior tests to which item has been subjected

b. Ammunition details (designations, calibre, packaging, lot numbers)

c. Drop and bounce orientations by round numbers

d. Radiographs of projectiles before and after pre-stressing of filling to check for cracks, adhesion to projectile wall, cavitation, exudation, porosity, etc.

e. Results of sectioning of projectiles after recovery, and radiographs and checks as in subparagraph d, above.

f. Behaviour of the projectile at muzzle exit and in its trajectory.

g. Firing date, barrel wear before and after firing test, and meteorological conditions

h. Chamber pressure.

i. Muzzle velocity.

j. Reference to Technical Data Package (TDP).

k. Results of visual and non destructive testing (NDT) inspections.

l. Fall of shot (Impact location).

ASSESSMENT CRITERIA

15. Projectiles shall be assessed using the following criteria:

a. There shall be no premature explosion or detonation in the bore or during flight.

b. There shall be no break-up or malfunction of the projectile and, where appropriate, the sub-munitions. For cargo rounds, there is to be no unacceptable distortion of the payload. Where there is distortion, the significance of this shall be explained by the developing nation.

c. There shall be no significant voids, cracks, HE dust, bonding failures or other unacceptable features in the condition of the projectile, and, where appropriate, the sub-munition filling. Where there is evidence of voids, cracks, bonding failure, or other unacceptable features, the significance of these shall be explained by the developing nation.

ANNEX D to
STANAG 4224
(Edition 3)

WORN BARREL TEST

AIM

1. To determine:

   a. If the non-explosive parts of the projectile can successfully withstand the maximum firing stresses in a worn barrel.

   b. If projectiles loaded with HE, other hazardous fillings, submunitions with HE or other hazardous fillings, and non hazardous projectiles which may or may not contain explosive or pyrotechnic components are bore and flight safe and do not produce erratic flight when fired from a worn barrel.

GENERAL

2. A worn barrel is defined as one that has no more than 25% wear life remaining as specified by the developing nation. Where the limiting condition of chrome plated barrels is erosion in the bore, then a modified test would be appropriate.

TEST PLAN

3. All Projectiles. Five inert projectiles shall be fired at the UFT and five at LFT and shall be recovered for examination. Checks shall be made for body engraving, damage to the driving band and any other significant defects. External ballistics shall be monitored.

4. Classes of Projectiles. These are additional requirements depending on the class of projectile.

   a. Projectiles loaded with HE or other hazardous fillings. Forty live projectiles with inert or dummy fuzes shall be fired at the UFT and 20 at the LFT. Ten hot and 10 cold conditioned projectiles should, if possible, be recovered after firing for radiographic examination and if necessary disassembly and sectioning.

   b. Projectiles loaded with submunitions with HE or other hazardous fillings.

      (1) Five projectiles with inert or dummy projectile fuzes, live expelling charges and inert fuze/live fill submunitions shall be fired at UFT and 5 at LFT. The projectiles should, if possible, be recovered after firing for radiographic examination, and if necessary disassembly and/or sectioning.

      (2) An additional 50 projectiles with live projectile fuzes and expelling charges but with either: a combination of live fuze/inert fill and inert fuze/live fill or live fuze/live fill submunitions shall be fired and functioned in flight. Thirty five are to be fired at UFT and 15 at LFT. A proportion of the ejected submunitions should, if possible, be recovered for radiographic examination, and if necessary disassembly and/or sectioning.

5. Charges

   a. Hot conditioned projectiles shall be fired by heating a suitable charge or by using a special charge designed to produce projectile PMP or the equivalent maximum acceleration or maximum rate of change of acceleration at the UFT in a new barrel.

   b. Cold conditioned projectiles shall be fired by temperature conditioning a suitable charge or by using a special charge designed to produce a pressure level that equates to the projectile mean adjusted pressure at LFT + 3 sd or the equivalent maximum acceleration or maximum rate of change of acceleration at LFT in a new barrel.

DATA

6. The following data shall be recorded and included in the test report:

a. Pre and post firing measurements of front and rear bourrelet diameters and projectile dimensions at appropriate points. Record any deformation.

b. Condition of driving band, band slippage, and band security and quality of engraving, etc. Include photographs, as necessary.

c. Visual and/or metallurgical examination for any break-up, cracks, body engraving, unscrewing of fuze or body sections, base integrity, etc.

d. Behaviour of the projectile at muzzle exit and in its trajectory.

e. Spin rate, as applicable.

f. Photographic evidence of satisfactory projectile launch.

g. Measurement of yaw at launch. For fin stabilized projectiles, evidence of lack of fin damage.

h. Reference to Technical Data Package (TDP).

i. Chamber pressure and MV.

j. Barrel wear and condition of bore before and after firing test.

k. Firing date and meteorological conditions.

l. Fall of shot (Impact location).

ASSESSMENT CRITERIA

7. Projectiles shall be assessed using the following criteria:

a. There are to be no prematures or break-up of the projectile, sub-munitions or payload components or any unacceptable deformation, cracks, body engraving, dimensional changes or other evidence of failure. The significance of any deformation shall be explained by the developing nation.

b. The driving band shall be correctly engraved and the projectile is to achieve the correct spin rate appropriate to the MV recorded.

c. MV, range and consistency of fall of shot shall be in accord with firing table data, or estimated data if firing tables are yet to be produced.

d. In the case of cargo projectiles, correct ejection and ballistics of the payload shall be achieved.

e. There shall be no premature explosion or detonation in the bore or during flight.

f. There shall be no break-up or malfunction of the projectile and, where appropriate, the sub-munitions. For cargo rounds, there shall be no unacceptable distortion of the payload. The significance of any distortion shall be explained by the developing nation.

g. There shall be no significant voids, cracks, HE dust, bonding failures or other unacceptable features in the condition of the projectile and, where appropriate, the sub-munition filling. Where there is evidence of voids, cracks, bonding failure, or other unacceptable features, the significance of these shall be explained by the developing nation.

ANNEX E to
STANAG 4224
(Edition 3)

SEQUENTIAL ENVIRONMENTAL TEST

AIM

1. To determine if the safety and suitability for service of the ammunition is adversely affected when it is subjected to environmental conditions representative of service use.

GENERAL

2. This test is designed to evaluate the effects on the ammunition of logistic and tactical transportation, storage and rough handling and underwater shock, where applicable, which the ammunition might experience in service in the specified climatic extreme conditions. The various test schedules simulate manufacturer-to-target sequences which provide a demanding but fair basis on which to judge the safety and suitability for service of the ammunition.

TEST PLAN

3. Ammunition. Projectiles, charges and primers selected from main or pre-production shall undergo this test. When zone charges are used, the charge should be selected from the Top Service Charge or the charge producing the highest acceleration or rate of change of acceleration.

4. Outline. The Sequential test outlines are presented at Figures E1-E4 as the mandatory minimum. Selection of a specific sequential test is dependent on the item to be tested. Additional environmental tests may be included in the sequence dependent on the forecasted life cycle environmental profile.

a. The Sequential test outlines are divided in two phases (Safety and Performance). The safety portion encompasses the prefiring environmental and firing conditions representative of the extremes that the test item may experience. The performance phase of the Sequential test is a control phase conducted using service charges and projectiles that have not been subjected to the most severe environments. If satisfactory performance is observed during the performance phase but significantly degraded performance is observed during the safety phase then further investigation testing may be required to determine the reason for the degradation in performance.

b. All test items shall be conditioned to the required temperature, and fired in a barrel in its first quarter of life.

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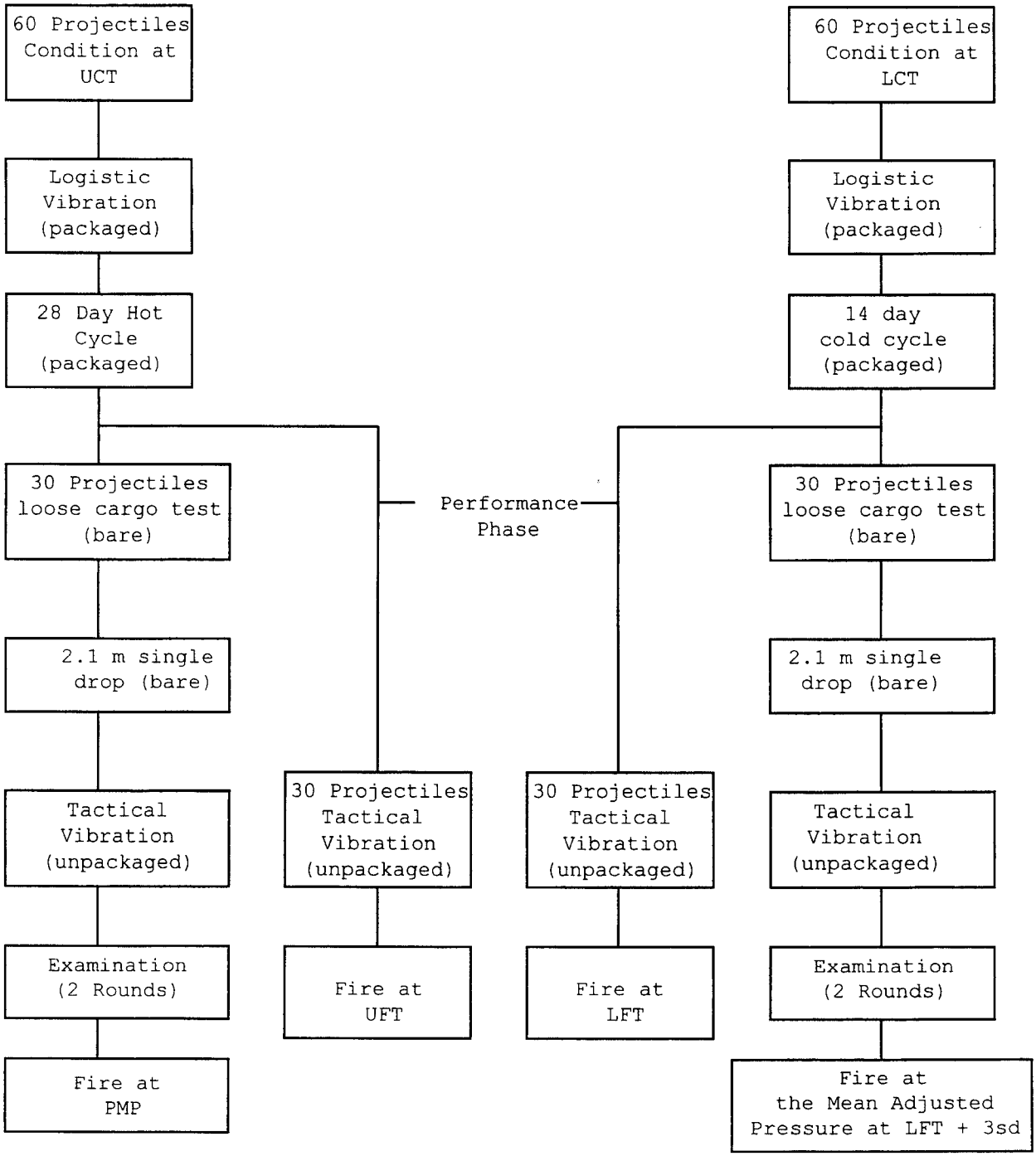

Figure E1. Sequential test for separate-loading projectiles.

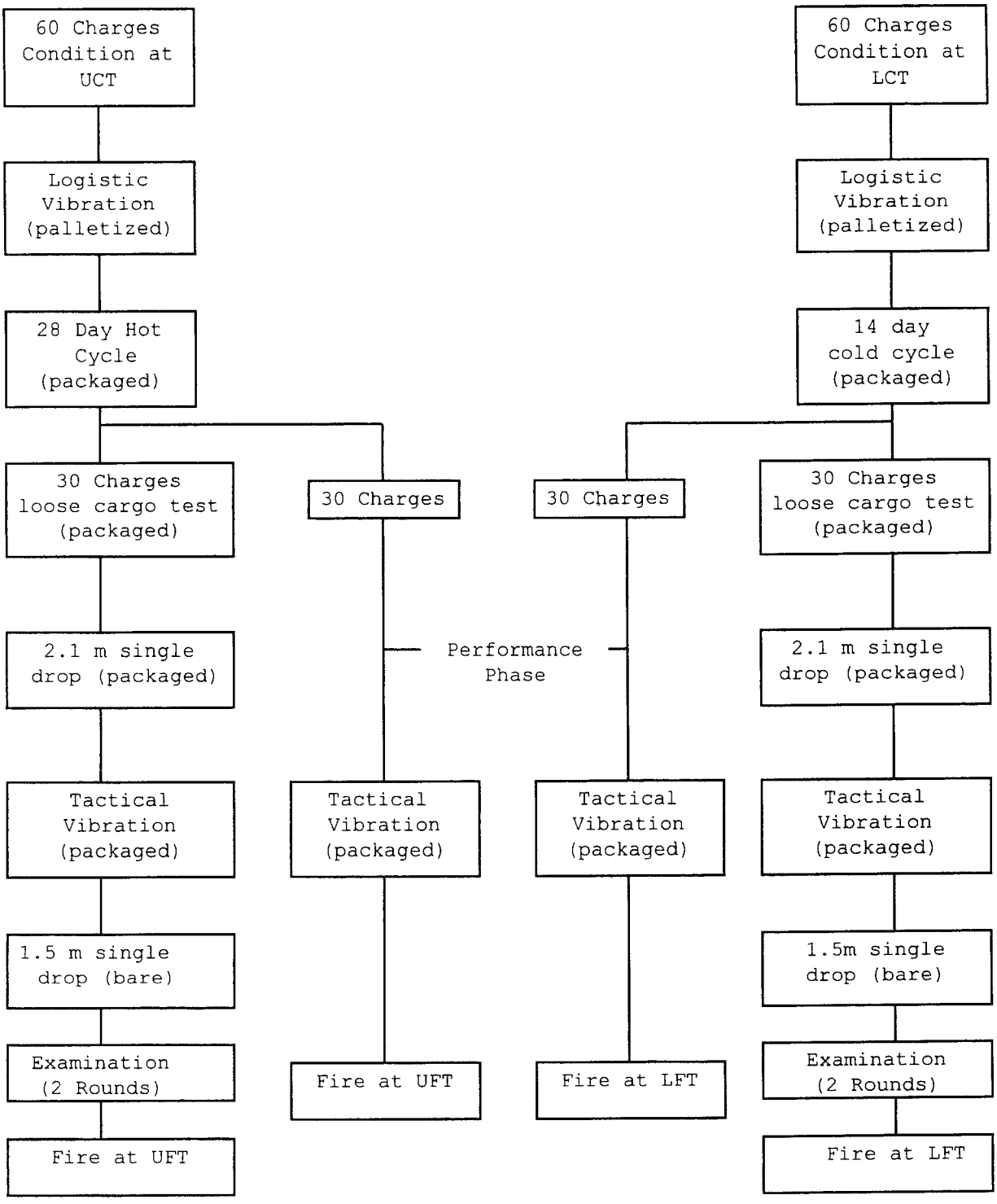

Figure E2. Sequential test for separate-loading propelling charges (individually packaged)

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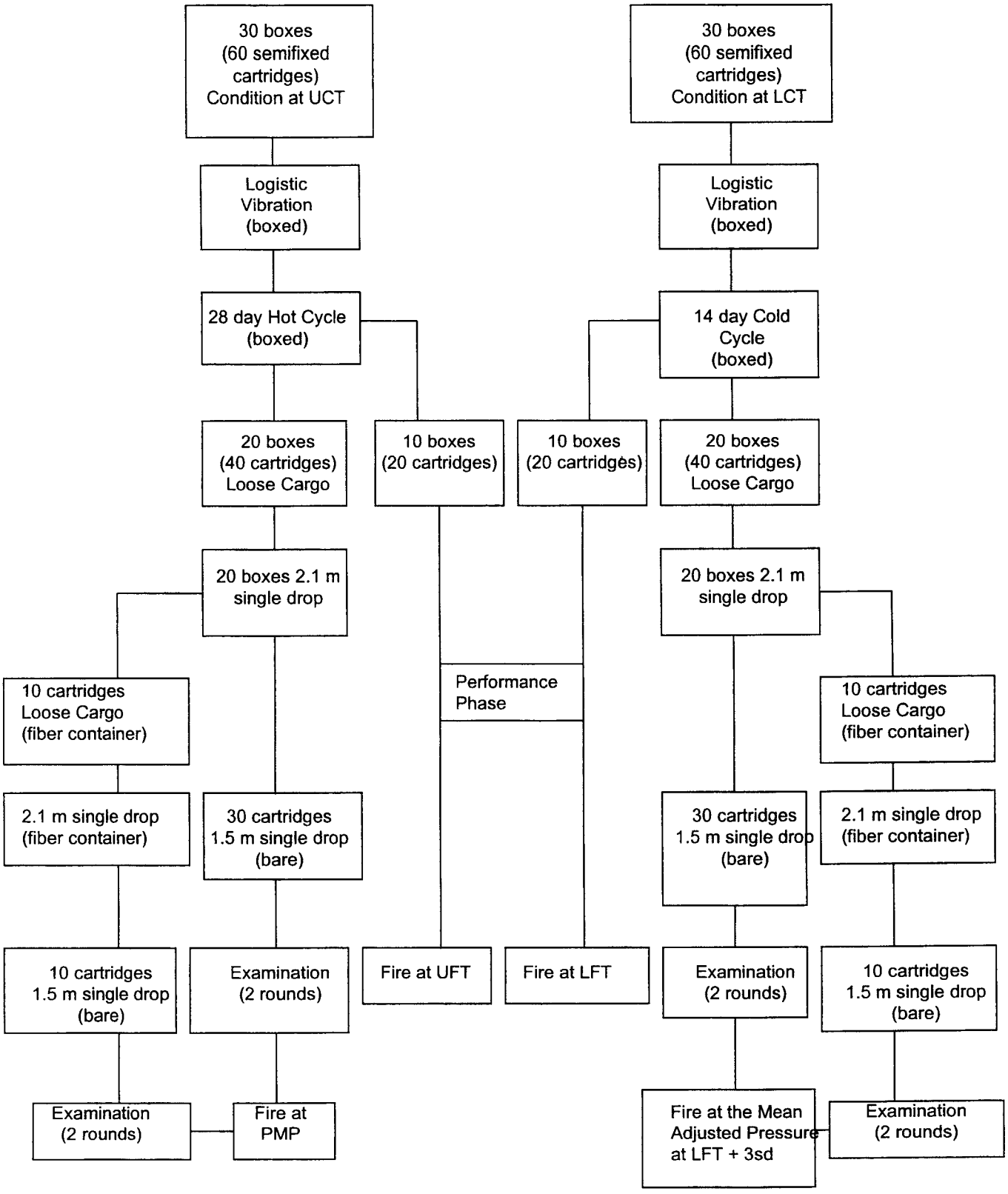

Figure E3. Sequential test for semifixed cartridges (packaged two fiber containers per box)

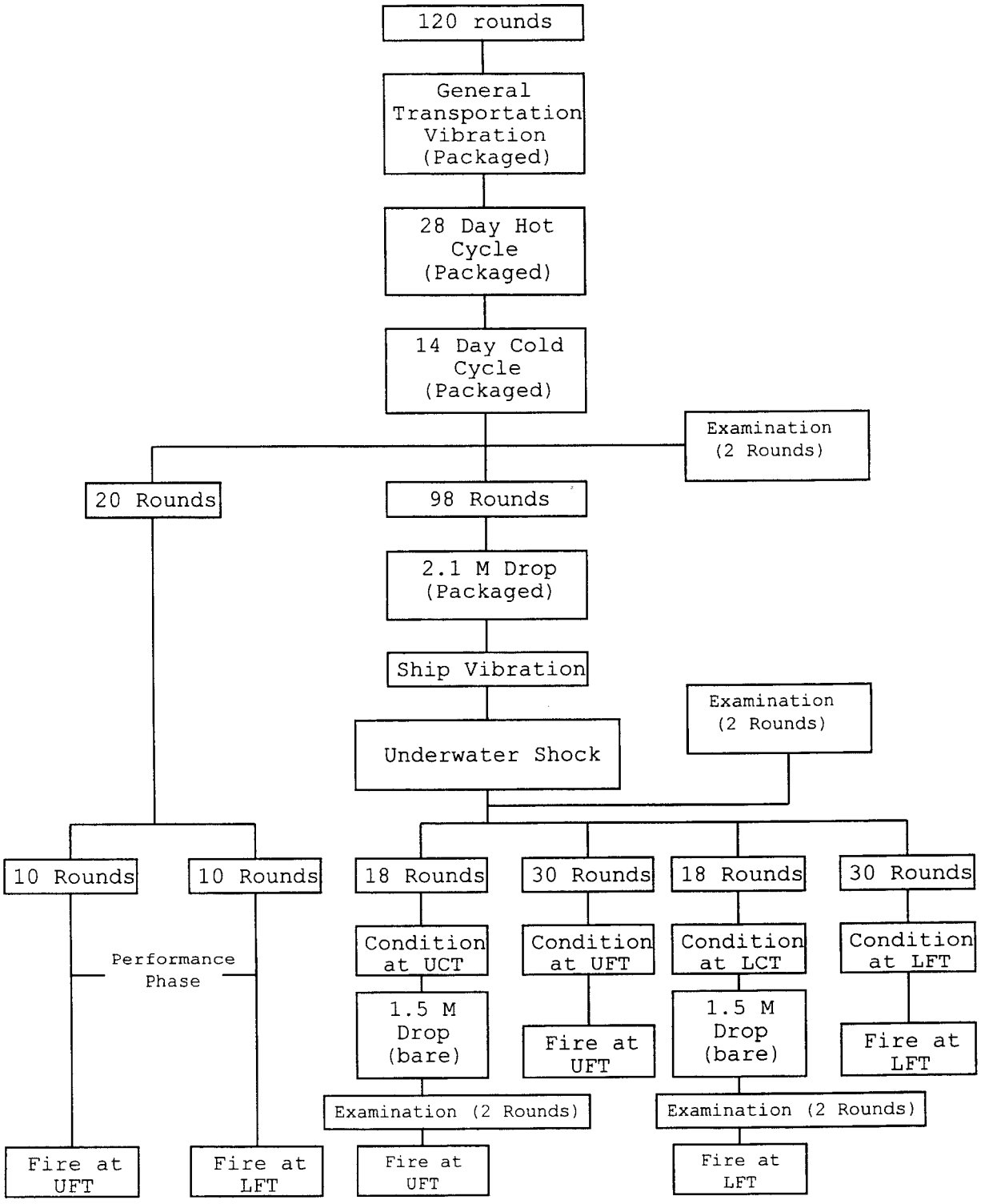

Figure E4. Sequential test for naval ammunition.

5. Diurnal Cycling and Climatic Conditioning. Ammunition shall undergo diurnal temperature cycling as specified in STANAG 2895 for storage and transit conditions for the required hot and cold climatic conditions. If artillery ammunition is intended for use in both the A1 and B3 or the A2 and B2 Climatic Categories, the B3 or B2 storage diurnal cycle shall be used respectively.

6. Vibration.

a. Logistic Vibration. Artillery ammunition in full packaging for logistic transportation shall be vibrated in each of the three mutually perpendicular axes at the UCT and the LCT according to the two-wheeled trailer and/or the combined wheeled vehicle and/or the tracked vehicle cargo schedule of STANAG 4370, (AECTP-400, Method 401) and STANAGs 4242.

b. General Transportation Vibration. All ammunition shall be tested to a generalized vibration level which represents initial transportation by road, rail, sea and/or air. The test shall be conducted in accordance with STANAG 4370, AECTP-400, Method 401.

c. Ship Vibration. Ammunition for transportation as cargo in ammunition supply ships, or for carriage in Warships' magazines, shall be subjected to swept sinusoidal vibration in each of the 3 major axes at 25 $\pm 10^{0}$C in accordance with STANAG 4370, AECTP-400, Method 401. If the mass of the store is such that it is normally transported in a ULC or palletized, then the test shall be conducted on a bare round. If the store is normally transported in a box, then the test shall be conducted on boxed ammunition.

d. Tactical Vibration. Ammunition transported in vehicle racks or vehicle bins shall be vibrated at the UCT and LCT according to the applicable installed equipment vibration test schedule for the vehicle. Where vibration test schedules are not available, national procedures should be used for unilateral projects or mutually agreed procedures for multilateral projects.

7. Loose Cargo Test. Artillery ammunition shall be tested at the UCT and the LCT on a transport simulator with a steel base. The base shall be subjected to a 25mm circular double amplitude motion by means of two synchronized cams at a speed of 300 rpm. Ammunition shall be packaged for tactical transportation either in Intermediate Packaging or Unpackaged. The samples shall be bounced in accordance with STANAG 4370, AECTP-400, Method 406.

8. Drop Test. Projectiles, charges and primers should be subjected to a 2.1 m Drop Test and/or 1.5 m Drop Test, as required, in accordance with STANAG 4375. The tests shall be conducted at UCT and LCT, except for the 2.1 m Drop Test conducted on naval ammunition which shall be carried out at 25 ± 10°C.

9. Underwater Shock. Ammunition shall be assessed and/or tested in accordance with Annex F.

10. Examination.

a. After each sub-test and before firing all ammunition shall be examined for any damage.

b. In addition, 2 rounds from the following shall be disassembled into components and examined for damage:

(1) Artillery Ammunition. Prior to the firing phase from each of the UCT and LCT test series.

(2) Naval Ammunition. After the 14 day cold cycle, the Underwater Shock test, and the 1.5 m Drop Test from each of the UCT and LCT test series, and prior to the firing phase from each of the UFT and LFT test series.

If the projectiles from the 2 rounds subjected to detailed examination contain HE, they shall be radiographed and/or sectioned to determine further the condition of the filling. Propellant shall be assessed for stability (STANAG 4117) or equivalent specification).

DATA

11. The following data shall be recorded and shall be included in the test report:

a. Prior test to which items have been subjected.

b. Results of performance checks.

c. Visual and/or metallurgical examination for any break-up, cracks, body engraving, unscrewing of fuze or body sections, base integrity, etc.

d. Behaviour of the projectile at muzzle exit and in its trajectory.

e. Spin rate, as applicable.

f. Photographic evidence of satisfactory projectile launch.

g. Measurement of yaw at launch. For fin stabilized projectiles, evidence of fin damage.

h. Reference to Technical Data Package (TDP).

i. Chamber pressure, MV and rate of fire, if applicable.

j. Barrel wear and condition of bore before and after firing test.

k. Firing date and meteorological conditions.

l. Fall of shot (Impact location).

ASSESSMENT CRITERIA

12. Ammunition shall be assessed using the following criteria:

a. The ammunition shall remain safe and suitable for service after all tests. The safety and suitability of the ammunition shall be assessed using the following criteria:

(1) After environmental tests, the ammunition shall be safe to load and fire unless it is clearly damaged too severely to be considered fit for service by the operator.

(2) When fired, the ammunition will be evaluated for proper functioning, but some performance degradation may be expected due to extreme environmental pre-conditioning. Safety, however, shall not be degraded, and any safety hazards to personnel or materiel shall be eliminated or controlled to an acceptable level.

b. With tests of packaged ammunition, the packaging shall protect the ammunition so that it is accessible and safe to remove and inspect. If inspection shows ammunition to be undamaged, it must be suitable for service.

ANNEX F to
STANAG 4224
(Edition 3)

UNDERWATER SHOCK TEST

AIM

1. To determine that the ammunition, when subjected to the shock of underwater explosion, will not endanger the vessel on which it is embarked, and where appropriate remain safe and suitable for service use.

GENERAL

2. Requirement. These tests are required where preliminary design study and testing indicates that the safety and suitability for service of the ammunition, whether packaged or bare, may be adversely affected by the shock of an underwater explosion.

3. Test Severity. There are two levels of severity of test. The severity of the underwater shock for each level of test severity is dependent upon the vessel intended for embarkation and, until a NATO standard has been agreed, upon the requirements of participating nations.

a. Ammunition Survival for Service Use. This is the level of underwater shock at which the ammunition must survive and remain safe and suitable for service use.

b. Vessel Survival Safety. This is the more severe test level, set at the maximum underwater shock that the vessel can safely survive. This is used to determine that the ammunition will not react in a way that will further endanger the vessel, and that the ammunition remains safe for handling and disposal. Where there is no visible damage then the munition shall also be safe to fire.

TEST PROCEDURE

4. Applicability

a. Land Service Ammunition. Land Service ammunition due to be transported in vessels is to be subjected to the Vessel Survival Safety Test. It may also, where required, be subjected to the Ammunition Survival for Service Use Test. Both of these tests would be stand alone tests.

b. Naval Ammunition. Naval ammunition is to be subjected to both the Vessel Survival Safety Test and the Ammunition Survival for Service Use Test. The Vessel Survival Test would be done as a stand alone test. The Survival for Service Use Test is to be conducted as part of the sequential environmental test as shown in Annex E, Figure E4.

5. Test Preparation

a. The simulation of ammunition installation and stowage in the vessel is to be carefully represented.

b. The test is to be conducted as detailed in the appropriate test procedure STANAG. If none exists, national, or mutually agreed multinational, procedures are to be used.

ANNEX F to
STANAG 4224
(Edition 3)

ASSESSMENT CRITERIA

6. The following assessment criteria shall be used:

a. Vessel Survival Safety. The ammunition shall survive the specified shock with no reaction of the explosive components, and shall remain safe for removal and disposal by qualified personnel. All safety features (shutters, barriers, switches etc.) shall remain at 'safe' and shall be ascertained to be so without disassembly. Where there is no visible damage then the munition shall also be safe to fire. (Damage does not include scratches, removal of paint or abrasians to the surface of the ammunition).

b. Ammunition Survival for Service Use. The ammunition is to survive the specified shock without damage, be fully serviceable and retain its required safety and performance capabilities.

ANNEX G to
STANAG 4224
(Edition 3)

ELECTROMAGNETIC RADIATION (NAVAL ENVIRONMENT)

AIM

1. To determine if the safety and suitability for service of ammunition to be embarked in naval vessels is adversely affected when it is subjected to the electromagnetic environment representative of service use.

GENERAL

2. The naval radio and radar frequency environment within which ammunition is to be assessed is given in STANAG 1307.

3. A test is only required when a preliminary assessment indicates that the safety or suitability for service of the ammunition, packaged or bare, may be affected by electromagnetic pickup within the above environment.

TEST PROCEDURE

4. The test should be conducted in accordance with an appropriate test STANAG when ratified. If none exists, national procedures should be used for unilateral projects or mutually agreed procedures for multilateral projects. The results of the test are to be reported in accordance with STANAG 4324.

ASSESSMENT CRITERIA

5. Until NATO assessment criteria are published in an appropriate STANAG, implementation of the STANAG 1307 RF environment and acceptance criteria should be to national documents which are to specify as minimum levels those given in MIL-STD-1385B, UK NES 1006 or DRAM-6.

RATIFICATION AND IMPLEMENTATION DETAILS
STADE DE RATIFICATION ET DE MISE EN APPLICATION

NATION	NATIONAL RATIFICATION REFERENCE DE LA RATIFICATION NATIONALE	NATIONAL IMPLEMENTING DOCUMENT NATIONAL DE MISE EN APPLICATION	IMPLEMENTATION / MISE EN APPLICATION					
			INTENDED DATE OF IMPLEMENTATION/ DATE PREVUE POUR MISE EN APPLICATION			DATE IMPLEMENTATION WAS ACHIEVED/ DATE REELLE DE MISE EN APPLICATION		
			NAVY MER	ARMY TERRE	AIR	NAVY MER	ARMY TERRE	AIR
BE	ZSP/OTAN S 010257 of/du 19.02.01	Not implementing/ Ne met pas en application						
CA								
CZ	6/2-18/2000-1419 of/du 26.07.00	STANAG		12.05	12.05			
DA +	FKO MAI2 204.69-S4224 9403558-011 of/du 18.06.01		06.02	06.02	N.I.			
FR								
GE	BMVg - Fu S IV 1 - Az 03-51-60 of/du 28.12.00	STANAG				06.99	06.99	06.99
GR								
HU								
IT								
LU								
NL *	M 2000004890 of/du 05.10.00	STANAG				06.01	06.01	06.01
NO	NSA- 72/01/FO/HST/ST4224 of/du 12.10.01		01.02	01.02	01.02			
PL								
PO								
SP								
TU								
UK *	D/Dstan/12/15/4541 of/du 30.04.01	STANAG				06.01	06.01	06.01
US	ITOP-4		06.01	06.01	06.01	06.01	06.01	06.01

* See reservations overleaf/voir réserves au verso
+See comments overleaf/Voir commentaires au verso

RESERVES/RESERVATIONS

THE NETHERLANDS	RNL Navy will, by means of a threat analysis, determine, the necessity and scope of the testing.
PAYS-BAS	*Les forces navales royales néerlandaises détermineront, au moyen d'une analyse du risque, la nécessité et l'ampleur des essais.*
UNITED KINGDOM	Figures E2, E3 and E4 When conducting sequential test to assess propelling charges for assessment UK will include two additional unstressed propelling charges for assessment, in accordance with STANAG 4117, as a control for comparison with the stressed charges.
Royaume-Uni	*Figures E, E3 et E4. Dans les essais séquentiels destinés à évaluer les charges propulsives, le Royaume-Uni inclura deux charges propulsives non comprimées supplémentaires, conformément au STANAG 4117, à titre de contrôle comparatif avec les charges comprimées.*

COMMENTS/COMMENTAIRES

DENMARK	The Royal Danish Air Force (RDAF) does not use weapons or munitions covered by this STANAG. The RDFA will therefore not implement STANAG 4224
DANEMARK	*La Royale Air Force du Danemark n'utilise pas les armes ou munitions couvertes par ce STANAG. donc, la RAFD ne mettra pas le présent STANAG en application.*